FIG.1

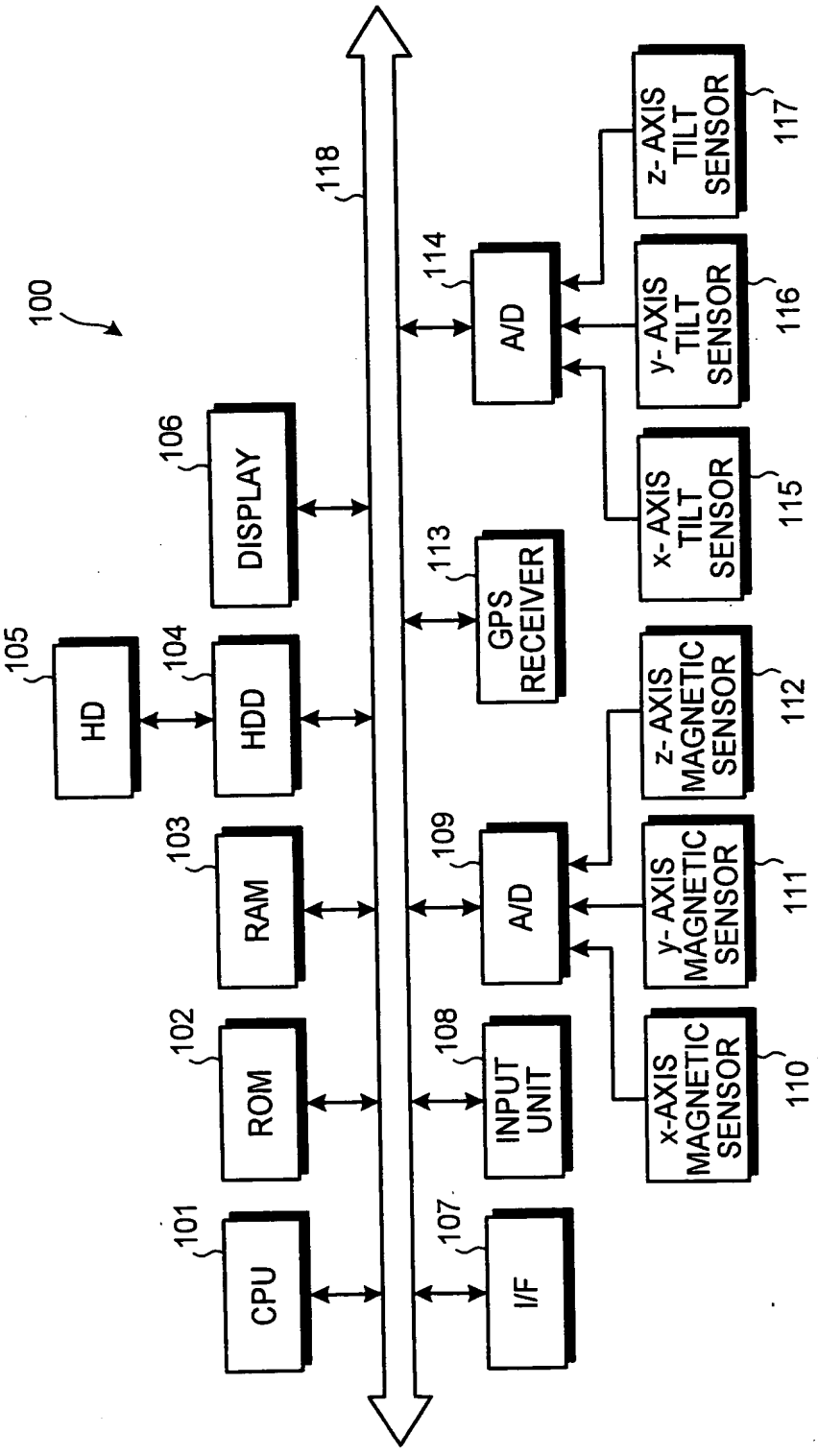

100
118
CPU
101
ROM
102
RAM
103
HDD
104
HD
105
DISPLAY
106
I/F
107
INPUT UNIT
108
A/D
109
GPS RECEIVER
113
A/D
114
x-AXIS MAGNETIC SENSOR
110
y- AXIS MAGNETIC SENSOR
111
z- AXIS MAGNETIC SENSOR
112
x- AXIS TILT SENSOR
115
y- AXIS TILT SENSOR
116
z- AXIS TILT SENSOR
117

FIG.2

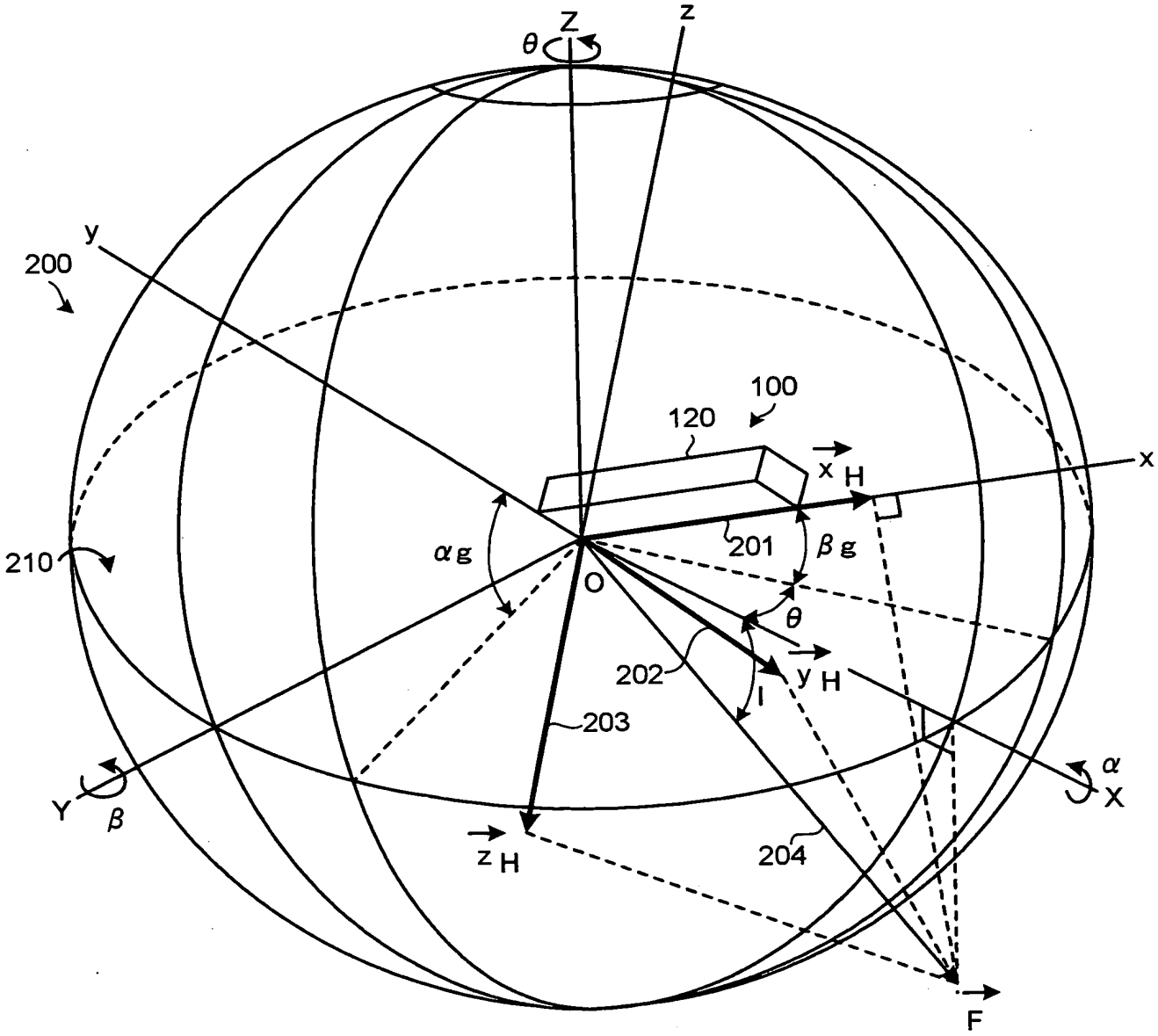


FIG.3

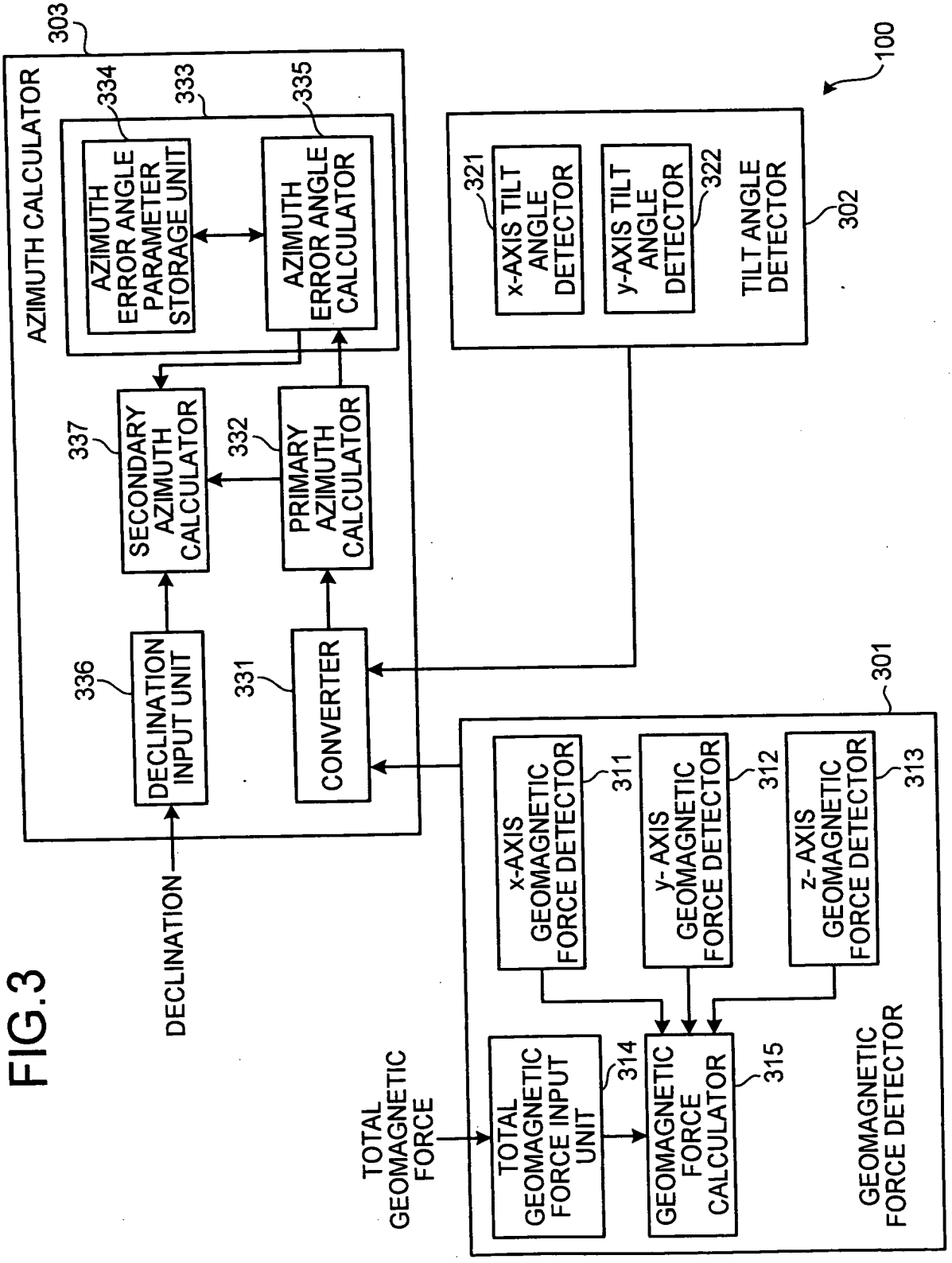

100
303
AZIMUTH CALCULATOR
334
AZIMUTH ERROR ANGLE PARAMETER STORAGE UNIT
333
335
AZIMUTH ERROR ANGLE CALCULATOR
321
x-AXIS TILT ANGLE DETECTOR
322
y-AXIS TILT ANGLE DETECTOR
TILT ANGLE DETECTOR
302
337
SECONDARY AZIMUTH CALCULATOR
332
PRIMARY AZIMUTH CALCULATOR
336
DECLINATION INPUT UNIT
331
CONVERTER
301
x-AXIS GEOMAGNETIC FORCE DETECTOR
311
y- AXIS GEOMAGNETIC FORCE DETECTOR
312
z- AXIS GEOMAGNETIC FORCE DETECTOR
313
DECLINATION
TOTAL GEOMAGNETIC FORCE
TOTAL GEOMAGNETIC FORCE INPUT UNIT
314
GEOMAGNETIC FORCE CALCULATOR
315
GEOMAGNETIC FORCE DETECTOR

FIG.4

ROLL ANGLE αg	PITCH ANGLE βg	AZIMUTH ERROR: OFFSET δ	AMPLITUDE WIDTH $W\theta$	PHASE DIFFERENCE ω
10.0	10.0	-1.76	0.18	+
20.0	20.0	-7.16	1.46	+
30.0	30.0	-16.89	5.29	+
30.0	-30.0	16.81	5.30	-
⋮	⋮	⋮	⋮	⋮

FIG.5

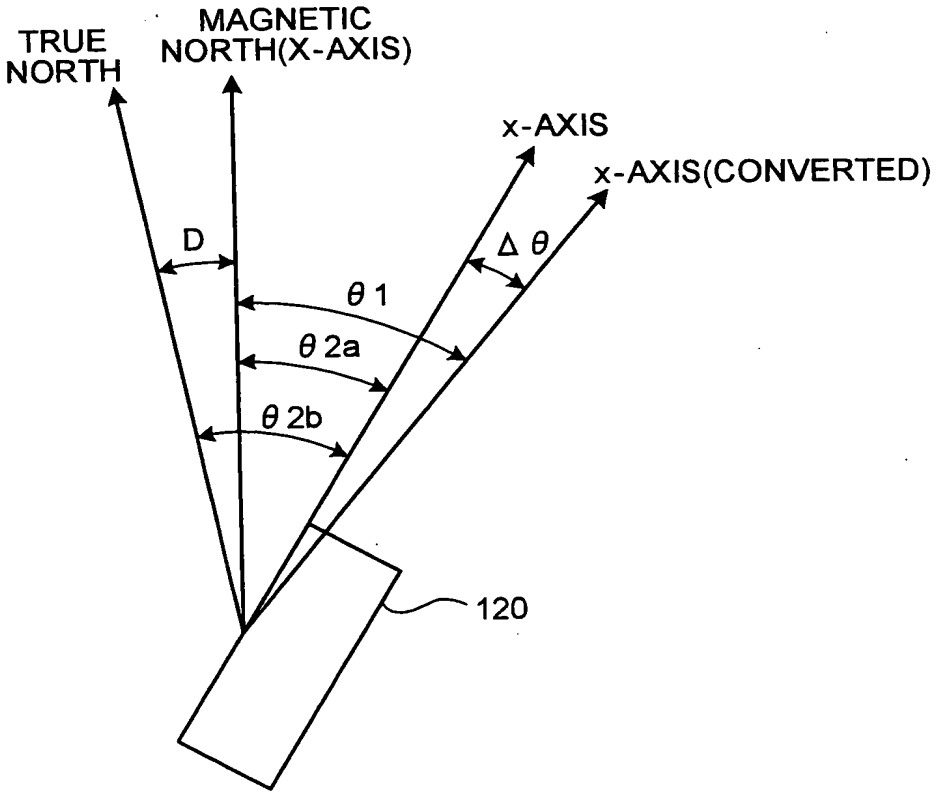


FIG.6

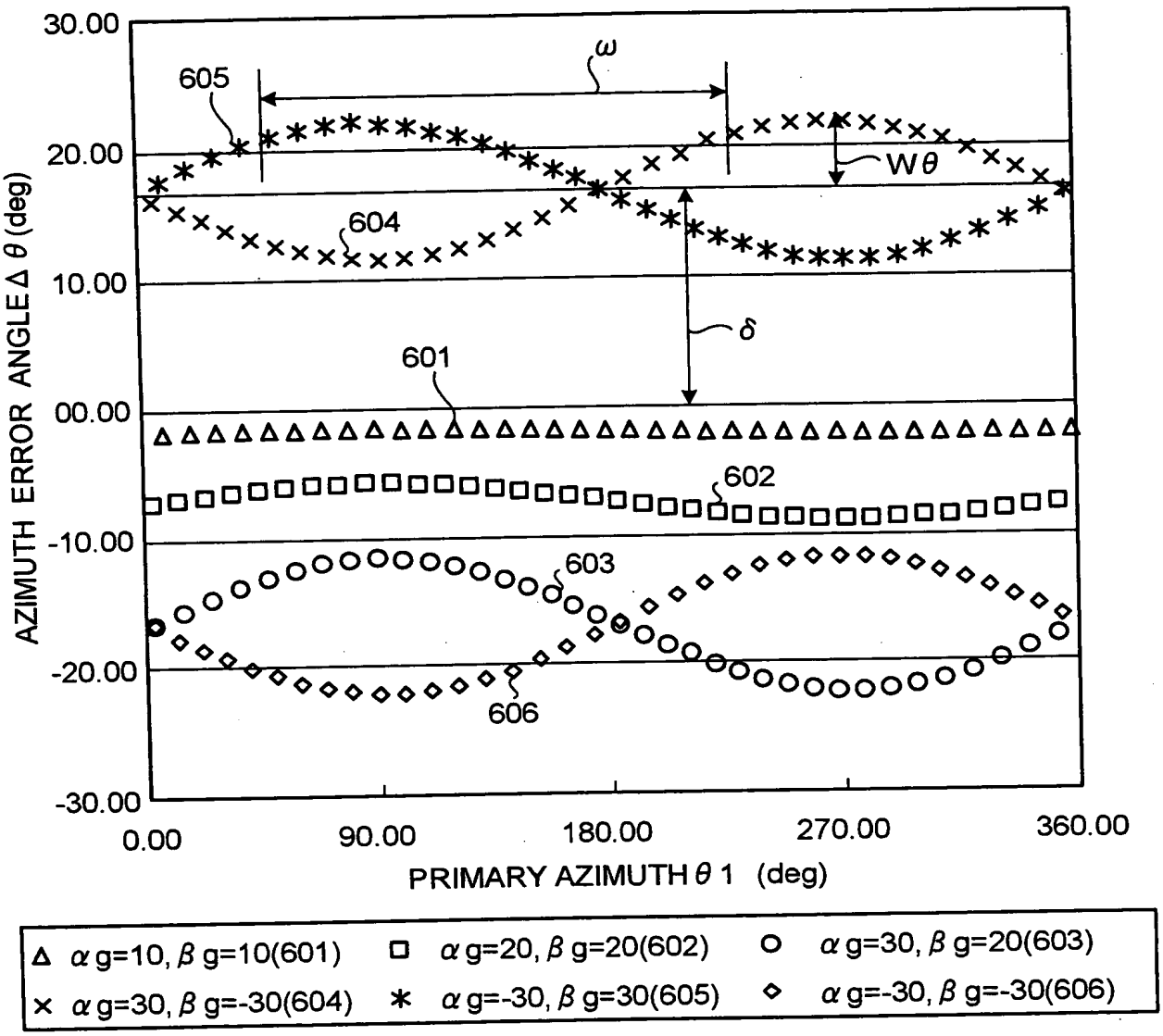

30.00
20.00
10.00
00.00
-10.00
-20.00
-30.00
AZIMUTH ERROR ANGLE Δ θ (deg)
0.00
90.00
180.00
270.00
360.00
PRIMARY AZIMUTH θ 1 (deg)
ω
Wθ
δ
605
604
601
602
603
606
Δ αg=10, βg=10(601)
□ αg=20, βg=20(602)
○ αg=30, βg=20(603)
× αg=30, βg=-30(604)
✱ αg=-30, βg=30(605)
◇ αg=-30, βg=-30(606)

FIG.7

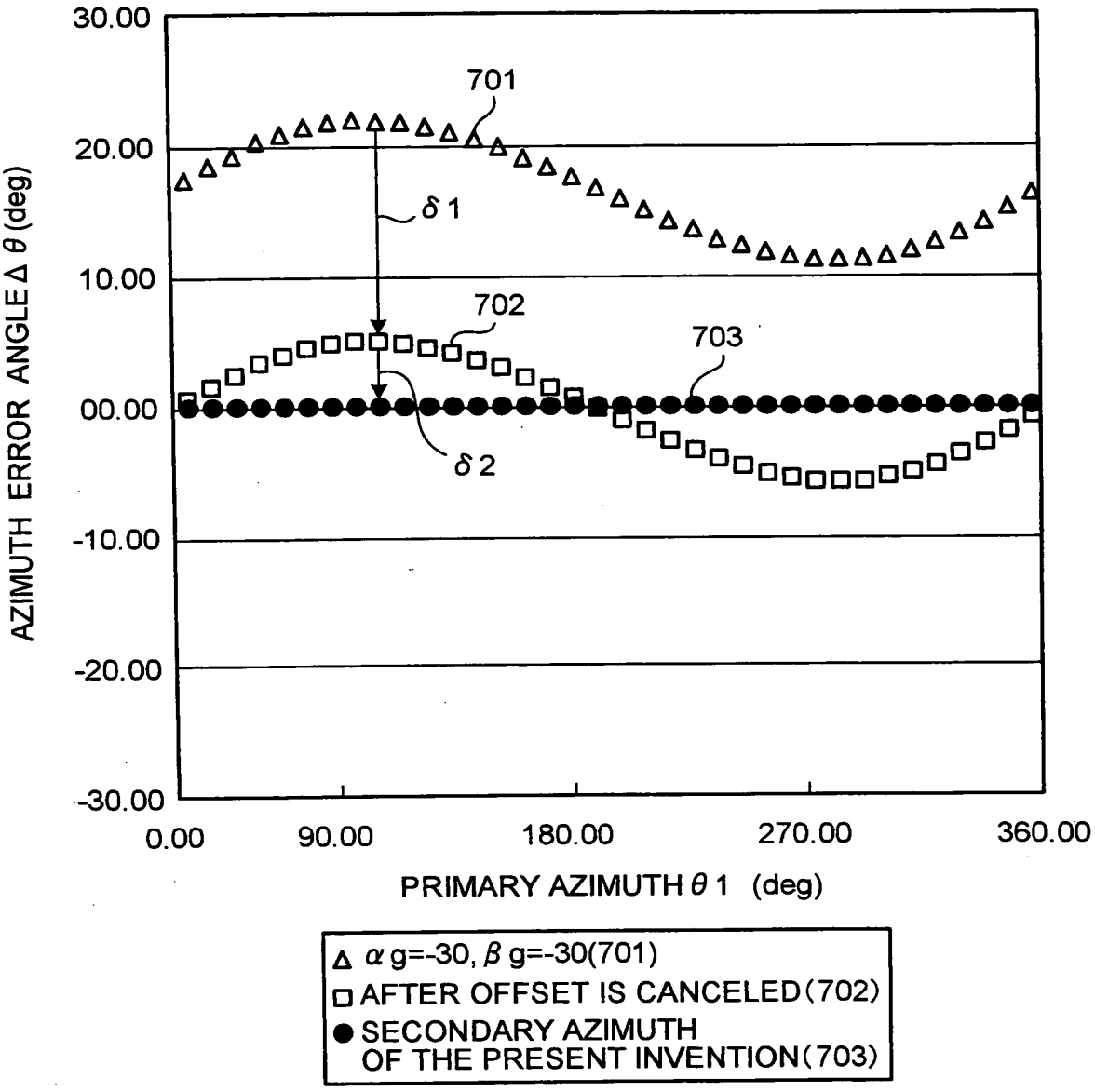

30.00
20.00
10.00
00.00
-10.00
-20.00
-30.00
0.00
90.00
180.00
270.00
360.00
AZIMUTH ERROR ANGLE Δ θ (deg)
PRIMARY AZIMUTH θ 1 (deg)
701
702
703
δ 1
δ 2
Δ α g=-30, β g=-30(701)
□ AFTER OFFSET IS CANCELED(702)
● SECONDARY AZIMUTH OF THE PRESENT INVENTION(703)

FIG.8

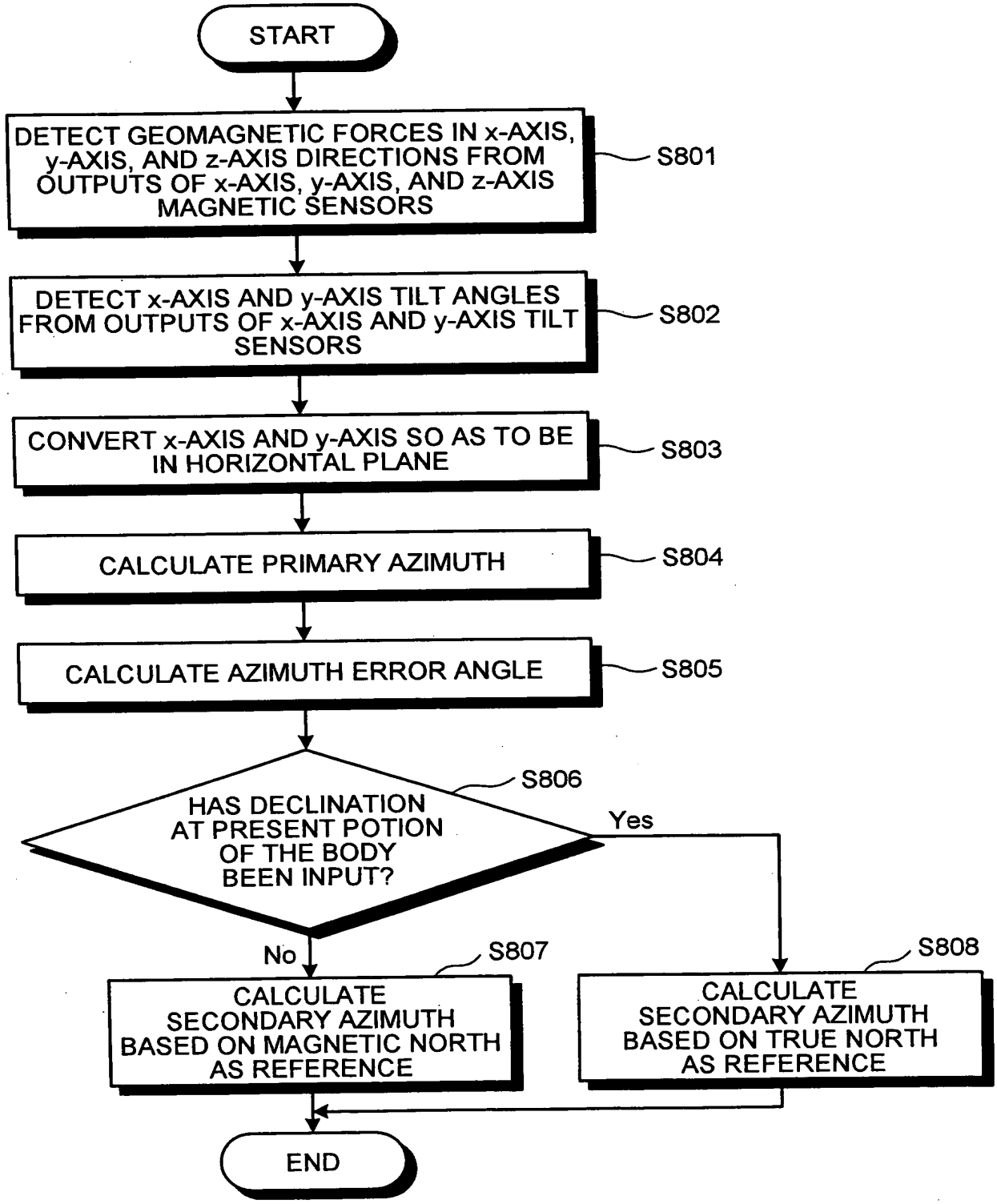

START
DETECT GEOMAGNETIC FORCES IN x-AXIS, y-AXIS, AND z-AXIS DIRECTIONS FROM OUTPUTS OF x-AXIS, y-AXIS, AND z-AXIS MAGNETIC SENSORS
S801
DETECT x-AXIS AND y-AXIS TILT ANGLES FROM OUTPUTS OF x-AXIS AND y-AXIS TILT SENSORS
S802
CONVERT x-AXIS AND y-AXIS SO AS TO BE IN HORIZONTAL PLANE
S803
CALCULATE PRIMARY AZIMUTH
S804
CALCULATE AZIMUTH ERROR ANGLE
S805
HAS DECLINATION AT PRESENT POTION OF THE BODY BEEN INPUT?
S806
Yes
No
S807
CALCULATE SECONDARY AZIMUTH BASED ON MAGNETIC NORTH AS REFERENCE
S808
CALCULATE SECONDARY AZIMUTH BASED ON TRUE NORTH AS REFERENCE
END

FIG.9

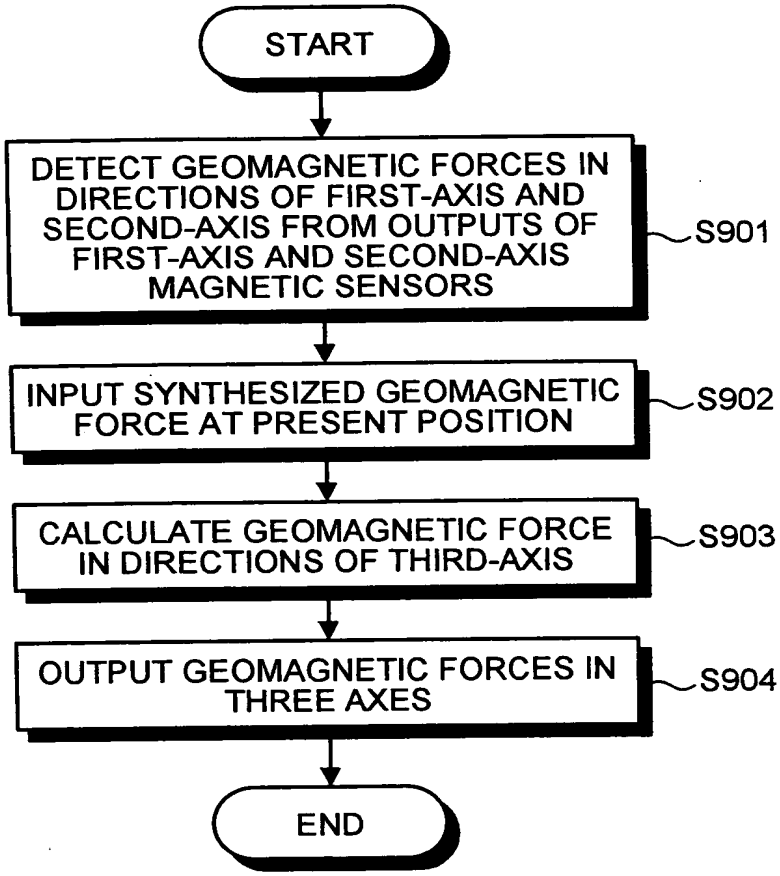
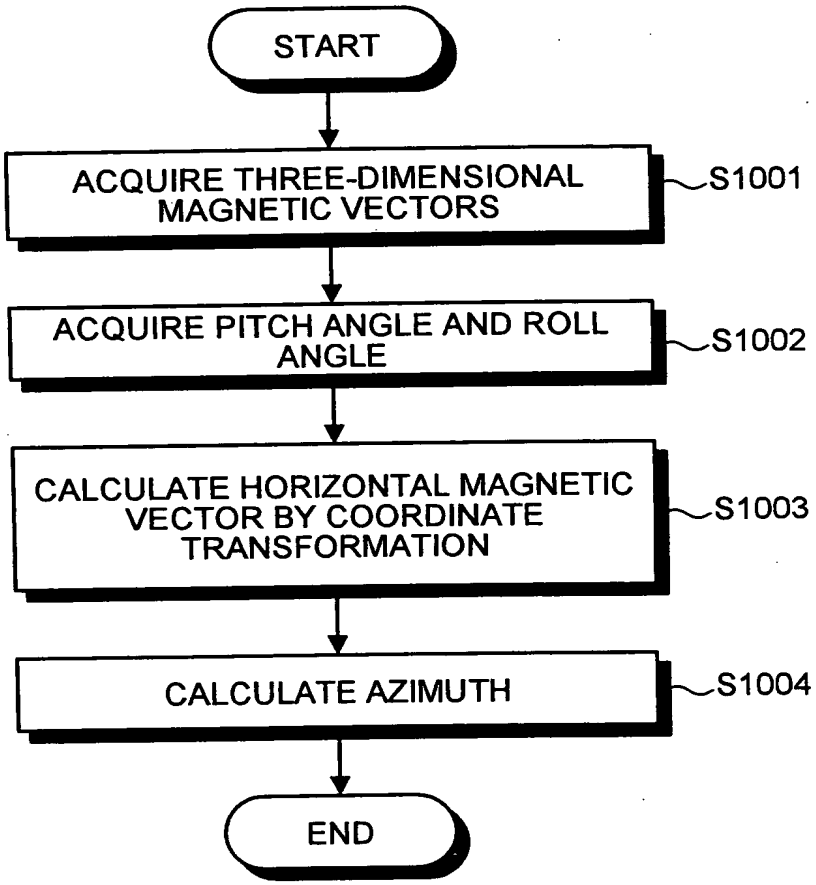

START
DETECT GEOMAGNETIC FORCES IN DIRECTIONS OF FIRST-AXIS AND SECOND-AXIS FROM OUTPUTS OF FIRST-AXIS AND SECOND-AXIS MAGNETIC SENSORS
S901
INPUT SYNTHESIZED GEOMAGNETIC FORCE AT PRESENT POSITION
S902
CALCULATE GEOMAGNETIC FORCE IN DIRECTIONS OF THIRD-AXIS
S903
OUTPUT GEOMAGNETIC FORCES IN THREE AXES
S904
END

FIG.10


START
ACQUIRE THREE-DIMENSIONAL MAGNETIC VECTORS
S1001
ACQUIRE PITCH ANGLE AND ROLL ANGLE
S1002
CALCULATE HORIZONTAL MAGNETIC VECTOR BY COORDINATE TRANSFORMATION
S1003
CALCULATE AZIMUTH
S1004
END